

Atomic Structure

Question1

The number of orbitals associated with ' N ' shell of an atom is

KCET 2025

Options:

A. 16

B. 32

C. 3

D. 4

Answer: A

Solution:

The "N" shell corresponds to principal quantum number $n = 4$. The total number of orbitals in a shell is given by n^2 .

Here, $n = 4$

So, number of orbitals = $4^2 = 16$

Answer: Option A (16)

Question2

According to the Heisenberg's Uncertainty principle, the value of Δb . Δx for an object whose mass is 10^{-6} kg is
($h = 6.626 \times 10^{-34}$ Js)



KCET 2025

Options:

A. $3.0 \times 10^{-24} \text{ m}^{-2} \text{ s}^{-1}$

B. $4.0 \times 10^{-26} \text{ m}^{-2} \text{ s}^{-1}$

C. $3.5 \times 10^{-25} \text{ m}^{-2} \text{ s}^{-1}$

D. $5.2 \times 10^{-29} \text{ m}^{-2} \text{ s}^{-1}$

Answer: D

Solution:

To determine the value of $\Delta v \cdot \Delta x$ for an object with a mass of 10^{-6} kg using Heisenberg's Uncertainty Principle, we start with the formula:

$$\Delta v \cdot \Delta x = \frac{h}{4\pi m}$$

Given:

Planck's constant, $h = 6.626 \times 10^{-34}$ Js

Mass, $m = 10^{-6}$ kg

Substitute these values into the formula:

$$\Delta v \cdot \Delta x = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 10^{-6}}$$

Calculating the above expression, we get:

$$\Delta v \cdot \Delta x \approx 5.2 \times 10^{-29} \text{ m}^{-2} \text{ s}^{-1}$$

This result provides the required uncertainty product for the given object under the constraints of Heisenberg's principle.

Question3

The energy associated with first orbit of He^+ is

KCET 2024

Options:

A. 0 J

B. -8.72×10^{-18} J

C. -4.58×10^{-18} J

D. -0.545×10^{-18} J

Answer: B

Solution:

Given :

Atomic number (Z) = 2

Principal quantum number (n) = 1

The formula for the energy of an orbit is :

$$E = -2.18 \times 10^{-18} \times \frac{Z^2}{n^2}$$

Substituting the values of Z and n into the formula, we get :

$$E = -2.18 \times 10^{-18} \times \frac{(2)^2}{(1)^2}$$

This simplifies to :

$$E = -8.72 \times 10^{-18} \text{ J}$$

Thus, the energy associated with the first orbit of He^+ is -8.72×10^{-18} J.

Question4

The number of protons, neutrons and electrons in the ion ${}_{16}^{32}\text{S}^{2-}$ respectively are

KCET 2023

Options:

A. 16, 18, 16

B. 16, 16, 18

C. 18, 16, 16

D. 16, 16, 16

Answer: B

Solution:

To find the number of protons, neutrons, and electrons in the sulfur ion ${}_{16}^{32}\text{S}^{2-}$, we can analyze the given atomic symbol:

The atomic number (lower subscript) corresponds to the number of protons. In this notation, the atomic number is 16, so sulfur has 16 protons.

The mass number (upper superscript) is the sum of protons and neutrons in the nucleus. Here, the mass number is 32. Since we already know there are 16 protons, we can find the number of neutrons by subtracting the number of protons from the mass number:

Number of neutrons = Mass number – Number of protons

Number of neutrons = $32 - 16$

Number of neutrons = 16

Lastly, the superscript $2-$ indicates the ion has a charge of -2 , which means there are two more electrons than protons in the ion (since electrons are negatively charged and each additional electron adds a negative charge). To find the number of electrons:

Number of electrons = Number of protons + 2

Number of electrons = $16 + 2$

Number of electrons = 18

Thus, the number of protons, neutrons, and electrons in the ${}_{16}^{32}\text{S}^{2-}$ ion are:

Protons: 16

Neutrons: 16

Electrons: 18

This corresponds to:

Option B

16, 16, 18



Question5

If wavelength of photon is 2.2×10^{-11} m and $h = 6.6 \times 10^{-34}$ J s, then momentum of photon

KCET 2022

Options:

A. 3.33×10^{-22} kg ms⁻¹

B. 1.452×10^{-44} kg ms⁻¹

C. $6.89 \times 10^{+43}$ kg ms⁻¹

D. 3×10^{-23} kg ms⁻¹

Answer: D

Solution:

Given, wavelength of photon,

$$\lambda = 22 \times 10^{-11} \text{ m}$$

Plank constant, $h = 6.6 \times 10^{-34}$ Js

We know that, $\lambda = \frac{h}{mc} \Rightarrow mc = \frac{h}{\lambda}$ and $mc =$ momentum

$$\begin{aligned} \therefore \text{Momentum} &= \frac{6.6 \times 10^{-34}}{2.2 \times 10^{-11}} \\ &= 3 \times 10^{-23} \text{ kg ms}^{-1} \end{aligned}$$

Question6

The number of angular and radial nodes in $3p$ orbital respectively are

KCET 2021

Options:



A. 3, 1

B. 1, 1

C. 2, 1

D. 2, 3

Answer: B

Solution:

For the given $3p$ orbital, the number of angular nodes, $l = 1$ (as it involve p orbital) As $n = 3$ and $l = 1$

\therefore Number of radial nodes = $n - l - 1$

$$= 3 - 1 - 1 = 1$$

Hence, angular and radial nodes in $3p$ orbital respectively are 1, 1.

Question7

With regard to photoelectric effect, identify the correct statement among the following.

KCET 2020

Options:

A. Energy of electron ejected increases with the increase in the intensity of incident light.

B. Number of electron ejected increases with the increase in the frequency of incident light.

C. Number of electron ejected increases with the increase in work function.

D. Number of electron ejected increases with the increase in the intensity of incident light.

Answer: D

Solution:



Photoelectric effect takes place when the rays of light falls on the surface of a metal with low ionisation energy, ejection of electrons from the surface of the metal takes place. The frequency of light being used, should be suitable. Also, the number of electrons emitted is directly proportional to the intensity of light but does not depend upon its frequency. However, the velocity of the emitted electrons is dependent on frequency of light used.

Question8

Two particle A and B are in motion. If the wavelength associated with ' A ' is 33.33 nm, the wavelength associated with ' B ' whose momentum is $\frac{1}{3}$ rd of ' A ' is

KCET 2019

Options:

- A. 1.0×10^{-8} m
- B. 2.5×10^{-8} m
- C. 1.25×10^{-7} m
- D. 1.0×10^{-7} m

Answer: D

Solution:

According to de-Broglie, wavelength (λ) and momentum (P) of a material particle is related as

$$\lambda = \frac{h}{P}$$

Given particles A and B are related as

$$\frac{\lambda_A}{\lambda_B} = \frac{P_B}{P_A} \quad \dots (i)$$

$$\lambda_A = 33.33 \times 10^{-9} \text{ (Given)}$$

According to the ques. $P_B = \frac{1}{3}P_A$. Substituting the value in Eq (i), we get

$$\frac{33.33 \times 10^{-9}}{\lambda_B} = \frac{1}{3}$$

$$\lambda_B = 99.99 \times 10^{-9} \text{ m}$$

$$= 0.9999 \times 10^{-7} \text{ m} \Rightarrow 1 \times 10^{-7} \text{ m}$$



Question9

The orbital nearest to the nucleus is

KCET 2018

Options:

A. $4f$

B. $5d$

C. $4s$

D. $7p$

Answer: C

Solution:

In general, orbitals with lower energy are located closer to the nucleus. The proximity of an orbital to the nucleus can be determined using the $(n + l)$ rule:

The orbital with the smaller sum of $(n + l)$ is closer to the nucleus.

If two orbitals have the same $(n + l)$ value, the one with the smaller n is closer to the nucleus.

Let's apply this to the given options:

Option A: $4f$

Here, $l = 3$, so $n + l = 4 + 3 = 7$.

Option B: $5d$

Here, $l = 2$, so $n + l = 5 + 2 = 7$.

Option C: $4s$

Here, $l = 0$, so $n + l = 4 + 0 = 4$.

Option D: $7p$

Here, $l = 1$, so $n + l = 7 + 1 = 8$.

From these calculations, the $4s$ orbital, with the lowest $(n + l)$ value of 4, is closest to the nucleus. Hence, option C is the correct answer.



Question10

The correct set of quantum number for the unpaired electrons of chlorine atom is

KCET 2017

Options:

A. $2, 1 - 1, +\frac{1}{2}$

B. $2, 0, 0, +\frac{1}{2}$

C. $3, 1, 1, \pm\frac{1}{2}$

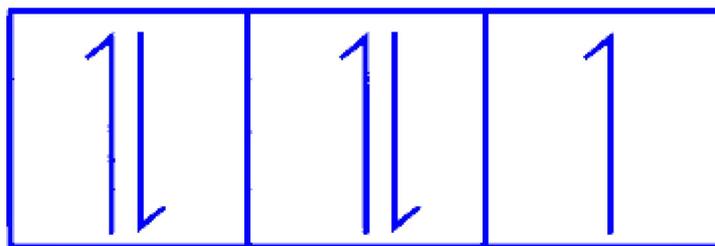
D. $3, 0, 0, \pm\frac{1}{2}$

Answer: C

Solution:

The electronic configuration of Cl would be $\Rightarrow 1s^2, 2s^2 2p^6, 3s^2 3p^5$

The p -orbital has 1 unpaired electron and the quantum number corresponding to it as



$$n = 3, l = 1, m = 1, s = \frac{1}{2}$$
